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The International Ice Patrol

By Lt.-Comdr. EDWARD H. SMITH, U.S. Coast Guard.

ONE of the gravest natural dangers which seamen of the North Atlantic have had to combat from early recorded times is that of floating ice. Winter conditions nowadays in the far north are especially favourable for ice production, and, in consequence, every spring two prominent ice streams project southward into the Atlantic. The general system of winds and currents casts an ice girdle along the eastern coast of Greenland and at the same times drives an equally imposing mass of white out of the north-west and the famous Baffin Bay. This last-mentioned ice, in which we are particularly interested, stretches a barrier far out into the Atlantic, the end of which often extends several hundred miles south of London in the longitude of Newfoundland. If we glance at a general map (see figure), we notice that the Arctic ice which is borne southwards along the western side of the North Atlantic, is greatly influenced by the bathymetrical configuration of the basin. Current and ice stream are preserved and guided by the continental slope of North America, which extends without great change in direction from the region of Baffin Land to the Tail of the Grand Banks. It has been justly remarked that the continental shelf, before finally merging into the ocean floor south-east of Newfoundland, juts out into the Atlantic to a point halfway between Pole and Equator.

It was off the Tail of the Grand Banks that the giant passenger

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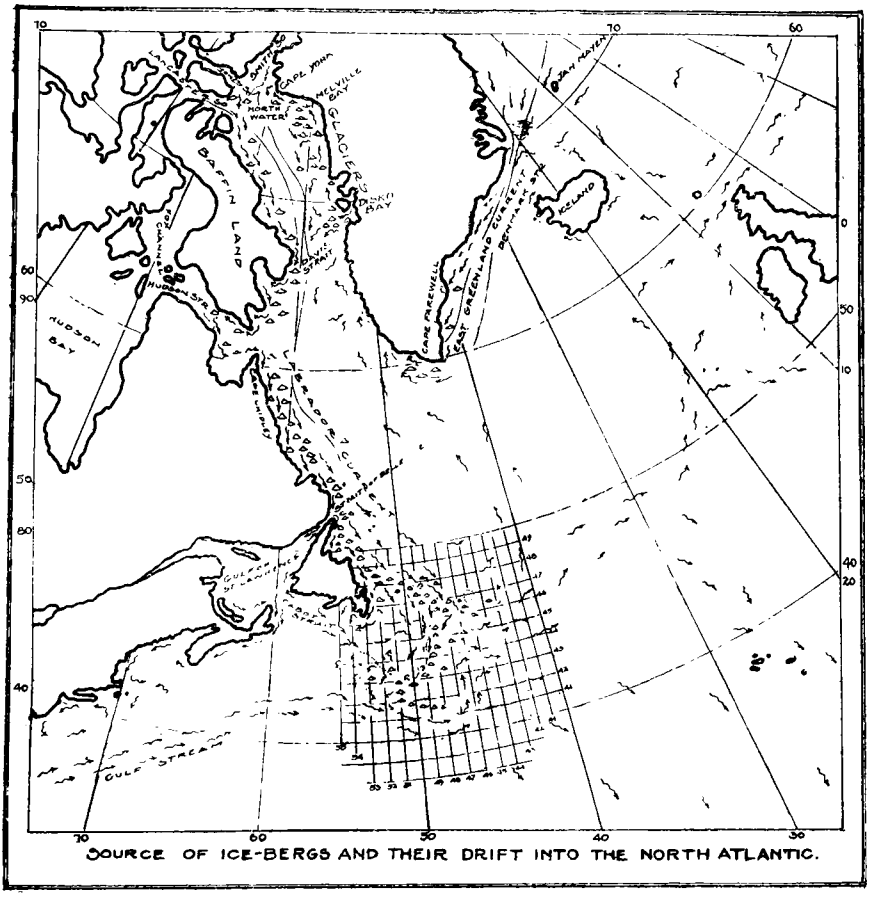
ship "Titanic" met the southern end of the Arctic barrier on the night of April 14th, 1912, and collided with a treacherous low-lying iceberg unseen by the bow look-outs. This most appalling marine disaster of modern days proved a culminating event, against the repetition of which measures were taken at an International Convention in London, 1914. It was decided at that Conference to establish a patrol of the ice regions of the North Atlantic, in order that all future navigators might be supplied with information regarding dangerous floating ice. The practicability of such a plan was insured by Marconi's then recent invention in wireless, which a few years previously had been installed extensively on ocean-going steamers. The United States accepted the actual management of the Ice Patrol service, each nation a party to the agreement binding themselves to share the expenses of such a project in proportion to the official shipping tonnages of each. (Great Britain contributes approximately thirty per cent. of the total outlay of funds.)

It has devolved upon the United States Coast Guard to furnish the Patrol with ships and personnel. The U.S. Hydrographic Office co-operates with the Coast Guard in giving publicity to the ice information. Under this general programme (with the exception of the war years 1917 and 1918, when the service was suspended), the Patrol has been operating for the past thirteen years. Collisions and damages on account of ice have occurred on some of the northern routes near Newfoundland, as they probably always will, but to the writer's knowledge there has not been a single life lost or a serious marine accident on the United States-Europe routes since Ice Patrol inception.

The work has two main features, viz.: (1) the practical task of locating all ice threatening the steamship tracks, and the duty of placing that information in the hands of every steamship captain; and (2) the making of such scientific observations as will lead to a better understanding and administration of the practical work. The former aspect is, of course, of primary importance, and depends upon a programme of intelligent scouting combined with an efficient system of radio communication.

The Patrol, in searching for menacing ice, finds it in two general forms, as it hails from two different sources, viz., sea ice and land ice. The former is the name given to ice formed on salt water, commonly known to seamen as field ice, and, being flat, is easily moved by prevailing winds and superficial currents. The field ice season south of Newfoundland usually lasts from February to May. Land ice, as it is met floating in the sea, consists of parts broken off from the ice sheets which cover certain land areas in the far north. Floating land ice, or icebergs, as they are commonly termed, because of their size and form, constitute a

far greater menace to navigation than does sea ice. The iceberg season may be said to cover the period March 15th to July 15th. The compiled drifts of icebergs, from a record kept by the Patrol, 1913-1925, indicate a tendency towards uniformity, both as to velocity and direction. The most dangerous bergs, that is those which reach low latitudes, generally follow a course which lies more or less parallel to the trend of the continental slope until



SOURCE OF ICE-BERGS AND THEIR DRIFT INTO THE NORTH ATLANTIC.

they arrive at the gateway to the Atlantic—The Tail of the Grand Banks (see figure). In this critical region of the North Atlantic, where two mighty currents meet, the drift of the icebergs cannot be foretold, but we observe that the majority of the bergs set south-westward until caught in the northern edge of the Gulf Stream, along which they are borne, to the east and the north-east. Continually lashed by the surrounding warm water, they disintegrate rapidly, and within a week's time no longer constitute a menace to navigation. The Patrol makes every effort to keep in touch with all such icebergs, sending out wireless broadcasts

twice daily regarding their position and drift. Every night an ice report is sent to the U.S. Hydrographic Office, and this is then made the subject both of radio broadcasts from U.S. coastal stations and printed notices to departing ships for Europe. Every day there are many ships which ask the Patrol for special ice information affecting their particular routes, and, in addition, two meteorological reports are forwarded to the Weather Bureau, Washington. It can be readily appreciated that an efficient and active radio communication is demanded, and to this end the ships are equipped with a complement of trained operators and the most powerful wireless equipment on the Atlantic.

The " Tampa " and the " Modoc " are the two ships detailed for Ice Patrol duty. They are 240 ft. in length, fitted with electric drive turbines capable of attaining a speed of 16 knots, and they carry one single, tall mast for long distance radio work. They base upon Halifax, Nova Scotia, each ship alternating with fifteen days in the ice regions south of Newfoundland. The practical work of ice scouting is greatly hampered, at times, by inclement natural elements. The prevailing atmospheric pressure distribution produces strong north-westerly winds over this region of the North Atlantic in winter, and less intense south-westerly winds later in the season and in summer. These two types of circulation are often interrupted, especially in winter, by irregular winds associated with low pressure centres moving eastward, the mean tracks of which follow a path along the northern edge of the Gulf Stream. It can be imagined that in the early ice season, both the practical, as well as the scientific work, is carried on with great difficulty, midst continually veering gales that lash these waters into a veritable fury. In the latter part of the ice season, May-July, the prevailing air circulation becomes southerly, and the gradients grow less intense. Warm winds blowing over the icy waters around the Banks bring a fog sheet which often does not lift for weeks at a time. The fact that the region most infested by bergs is also the region enveloped in fog for a large percentage of the time, greatly increases the danger of collision with ice.

It was early realised that the Patrol could not give its best service to shipping unless a carefully planned scientific programme was begun from which conclusions of practical value might be drawn. The most important natural problems confronting the Ice Patrol have been: (1) determination of the position of an iceberg when not visible because of fog, snow, or darkness; (2) information regarding the probable drift of ice after arriving at the gateway to the Atlantic; (3) advanced information about the annual amount of ice to be expected south of Newfoundland.

(1) No device has yet been constructed which detects the presence of an iceberg, the proximity of which is unknown because

of low visibility. The Patrol is conducting at present, however, a series of experimental tests with a new invention by which it is hoped to locate the position of a berg by means of submarine echo. Sounds emitted from a submarine sonic apparatus may be reflected by the under-water body of a berg in such a manner that the echo can be caught in a microphone.

(2) If the Patrol had knowledge of the drift tracks which bergs would follow after arrival at the Tail of the Grand Banks, much more detailed reports could be furnished to approaching vessels, especially during the protracted periods when fog enshrouds the cold-water region. The Patrol has found that the drifts of nearly all bergs are primarily controlled by relatively deep-seated ocean currents, and the effect of the winds such as those which usually prevail from April to July in this region, are practically nil. A monthly current map (for oceanic circulation does not fluctuate so rapidly as does the atmospheric) of this critical area, where the Labrador Current and Gulf Stream meet, is an indicator of the courses menacing bergs will tend to follow. A practical means of determining the circulation over a given oceanic area will be instituted on the 1926 Patrol: the methods employed are based upon the general theories propounded in Bjerknes' "Dynamic Hydrography and Meteorology," *Carnegie Institute Publications*, 1910. The success or failure of forecasting by such a programme as suggested above, depends to a great extent upon the rate at which variations take place in the courses of the currents. Obviously, little reliability can be attached to a monthly current map if important changes occur in the circulation from day to day, or week to week. Investigation of this particular question has been recently carried on at the Geo-Physical Institute, Bergen, Norway, under the supervision of B. Helland-Hansen, use being made of the material collected by the Ice Patrol around the Grand Banks in years past. The requisite data consist of salinity and temperature observations at several depths and from stations scattered net-like over the investigated area. We have found several different positions occupied by the two counter streams (the Labrador Current and the Gulf Stream) at the gateway to the Atlantic, depending partly upon the relative volumes of each in particular years, and also upon the time within a given year. Alterations in direction and velocity of the currents, however, take place at such a slow rate, that a current map constructed along the lines described above will continue to be of value for a period of even three or four weeks.

Several interesting discoveries have been revealed in the course of this work, and may be alluded to briefly. The famous "cold-wall" of oceanography, which is so clearly delineated along the entire American coast, does not mark the boundary between the

Gulf Stream and the variable counter-set inshore, as is commonly supposed. The change in flow, on the contrary, is located at the density-wall, and this phenomenon, it was found, lies 20 to 30 miles inshore of the famous " cold-wall " around the Grand Banks. If this be a hydrostatic phenomenon, it may be attributable to the inshore water salting faster than it warms, but in any case it causes a considerable amount of the icy water to flow in the same direction and parallel to the Gulf Stream. The dissimilarity, too, between the positions of the " cold-wall " and the " density-wall " more or less upsets a view, hitherto held by many, that an intense sinking of the water (especially that from the Arctic), is constantly taking place along the length of the " cold-wall." Further, the belief is not tenable that the Labrador Current dives beneath the Gulf Stream, for, as a matter of fact, the edges of these two currents have about the same density where they meet. The resulting mixture, it is true (as proved by Hydrographical Tables), is denser than either one, yet even this can cause no actual sinking of the water particles, because our rotating earth relegates movements solely to a lateral current in a direction making an angle of 90 degrees with the density gradient. Sir Napier Shaw, in *The Air and its Ways*, has pointed out an analogous condition, where the vertical descent of air in high pressure systems is about 300 ft. per day ; a movement which is really negligible when compared with the lateral velocity of the wind around such centres. Meteorologists, and others, who are constantly meeting problems which involve the important influence that the sea is known to exert upon our weather, will do well, when treating the sea, to employ the great parallelisms existing between the dynamic laws for the sea and for the air.

Let us return from this digression to the third important problem of the Ice Patrol, namely the great annual variations in the distribution of ice south of Newfoundland. If the master of the " Titanic " had known, as we can clearly see to-day, that the year 1912 was one in which icebergs by the hundreds invaded the North Atlantic to low latitudes, he would have navigated his command farther south and more cautiously past the Arctic ice barrier. The amount of ice drifting out of the north into the open Atlantic is subject to great annual variations. Several investigations have been made of the relation between amounts of ice in the north-eastern North Atlantic*†‡ and logical contri-

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* MEINARDUS, W. Periodische Schwankungen der Eistrift. *Ann. Hydr. Hamburg*, 1906. pp. 148-9, 227-239, 278-285.

† WEISE, W. Polareis und atmosphärische Schwankungen. *Geog. Ann. Stockholm*, 6 (1924). pp. 273-299.

‡ BRENNECKE, W. Beziehungen zwischen der Luftdruckverteilung und den Eisverhältnissen des Ostgrönländischen Meeres. *Ann. Hydr. Hamburg*, 1904. pp. 49-62.

butory factors, but only a few similar papers have dealt with the ice stream past Newfoundland*‡.

It is interesting to note, however, that all these investigators find the wind to be the most important influence which governs the southward drift of the Polar ice. The writer, with the assistance of the material in the Meteorological Office Library, South Kensington, has been comparing various pressure gradient effects with the ice distribution past Newfoundland. This work has been carried on in the interests of the International Ice Patrol with the express hope that results would justify, and lead to, the publication of a North Atlantic ice forecast, the value of which has been pointed out in the example given of the year 1912. The period investigated embraces forty-five years (1880-1924), a series of sufficient length to permit mathematical correlation, and in this respect it has an advantage over previous works.

The results differ somewhat from those previously obtained by Mecking* in that the chief importance is assigned to the variations of the pressure difference between Belle Isle, in Newfoundland, and Ivigtut, in South Greenland, during the period December to March. This pressure difference directly affects the amount of field ice, and it has been found that there is a very close relation between the amount of field ice and the number of bergs south of Newfoundland. The field ice tends to act as a fender along the shoreward side of the Labrador Current, and thus more or less prevents the icebergs from stranding as they are borne southwards. The truth of this statement was curiously revealed during the 1924 Patrol, when the unusual absence of field ice left the season's crop of bergs to strand in the northern waters. When the sea ice recedes northward, due to melting in May, the coastline becomes more and more exposed. Stranding takes place on a great scale, and the consequent supply of bergs to the Grand Banks is cut off. The iceberg menace to steamships in the North Atlantic would be greatly diminished, or practically disappear, if sea ice did not hamper the North American coast line from February to March every year. The pressure difference between Bergen and Stykkisolm during the period October to January was also found to be of importance.

The use of the pressure difference between various points furnishes the best data for forecasting purposes, because there is no room for the personal bias which may come in when charts are classified according to types. A classification of the charts of pressure anomaly over the North Atlantic during the period

* MECKING, L. Die Eistrift aus dem Bereich der Baffin Bai usw. *Veröff. Inst. Meeresk Berlin* 7, 1906. p. 148.

‡ SCHOTT, G. Über die Grenzen des Treibeises bei der Neufundländbank sowie über eine Beziehung zwischen neufundländischen und ostgrönländischen Treibeis. *Ann. Hydr. Hamburg*, 1904. pp. 305-309.

December to March has, however, been made, and this distinctly reveals two types of pressure distribution—a plus type, in which an excess of pressure centred in the region of Iceland more or less dominates the Atlantic north of the Azores, and a minus type when reverse conditions prevail. The plus type is subject to further classification into "1" and "2," depending upon a relatively great or moderate intensity of the excess pressure mass, both of which are reflected in a relatively very light, or light, ice year respectively in the western North Atlantic. The minus type, although unmistakably showing a greater amount of ice than normal, does not permit sub-grouping. In other words, the plus type of pressure conditions exhibits a higher correlation with poor ice years than does the minus type with correspondingly rich ice years. This indicates the presence of other factors, such as variations in the air and water temperatures in the far north, or variations in precipitation, or perhaps an unnatural phenomenon, such as an ice jam in the Arctic archipelago.

Although the investigation is not yet completed at the present writing, the results already indicate a high degree of success for such a method of ice forecasting. Correlation coefficients have been calculated between the following variables :—

(A) Number of bergs (on a scale of 0—10).

(B) Amount of field ice (on a scale of 0—10).

(C) Pressure difference (in millibars) between Belle Isle and Ivigtut, combined with the deviation of pressure from normal at Stykkisholm during the period December to March. The mean pressure difference is calculated from the combination : $4 \times$ Dec. $+ 3 \times$ Jan. $+ 2 \times$ Feb. $+ 2 \times$ March, and this mean is combined with the pressure deviation at Stykkisholm in the proportion of six to one.

(D) The pressure difference between Bergen and Stykkisholm during the period October to January inclusive, December being given double weight.

The correlation coefficients employed in the preparation of the forecast were as follows :—

Between (A) and (B)	+ 0·87
Between (A) and (C)	— 0·62
Between (A) and (D)	+ 0·60

At the end of March a forecast of the number of bergs can be prepared by means of the regression equation :—

$$\text{Bergs} = 4{\cdot}9 - 0{\cdot}11\ (\text{C}) + 0{\cdot}05\ (\text{D}).$$

At the end of the field ice season, April 15th, the number of bergs, May to July, can be predicted very closely by making use of the high correlation between field ice and bergs.

Arrangements are now being made to begin a service of North Atlantic ice forecasting, based on these relationships, and beginning with the season of 1926.

Weather Forecasting with the Help of the Sun

It is well known that practically the whole of the energy involved in maintaining the circulation of the earth's atmosphere is derived from the sun's radiation. The determinations of this quantity, carried out by the Astrophysical Observatory of the Smithsonian Institution since 1906, appear to show that it is not really a constant, but may vary by at least six per cent. on either side of the mean. These variations, if real, ought to be followed by changes in the atmospheric circulation and in fact, logically, they should account for all such variations. If by patient research we can unveil the mechanism of the connexion between solar and atmospheric phenomena, we shall have added a powerful weapon to the forecaster's armoury. Some years ago Mr. H. H. Clayton, as a result of investigations in the Argentine, considered that he had sufficient knowledge to bring this weapon into use, and weekly forecasts for Buenos Aires based only on solar observations have been issued regularly since July, 1922. Mr. Clayton has lately been engaged on similar researches in North America, and for some months has been making experimental long-range forecasts for New York.

The results of these attempts have recently been described in three monographs* published by the Smithsonian Institution. The first is a reply by Dr. C. G. Abbot to a criticism which had been made against the validity of the solar observations themselves. Professor Marvin had pointed out that the magnitude of the day-to-day variations of the calculated " solar constant " was much greater in the earliest observations than in the most recent, and showed a steady decrease throughout the whole period. If the rate of decrease is maintained these day-to-day fluctuations will practically disappear in a few years and only the long-period variations will remain. This suggests that the differences between one day and the next are mainly "accidental," due to deficiencies in the methods, which are gradually being eliminated with improvements in skill, knowledge and instrumental equipment. Dr. Abbot has investigated these criticisms in detail, and makes out a satisfactory case for the reality of the short period fluctuations, although he admits that the observations are not yet impeccable and that further improvement is required before forecasting by the sun becomes really reliable. The fluctuations have shown a close relation with the presence and especially with the position of sunspots, and Mr. Clayton has succeeded in making successful forecasts of the solar

* *Smithsonian Miscellaneous Collections*, Vol. 77, No. 5, Solar Variation and Forecasting, by C. G. Abbot; No. 6, Solar Radiation and Weather, or Forecasting Weather from Observations of the Sun, by H. H. Clayton; No. 7, Solar radiation and the Weekly Weather Forecast of the Argentine Meteorological Service, by Guillermo Hoxmark, Washington, 1925.

constant five days ahead by means of visual observations of the sun.

In the second paper Mr. Clayton describes the basis of his North American forecasts. On days with high solar radiation an anti-cyclone appears in the west of North America, and, the higher the solar radiation, the further north is the location of the anti-cyclone. With low solar radiation a depression appears, with a similar variation in location. The anti-cyclone or depression moves eastward in the usual way, and three days later it affects the Atlantic coast. The element actually selected for experimental forecasts was temperature at New York; a temperature 5°F. or more above the normal for the day was termed high, one 5°F. or more below the normal was termed low; between these limits was "normal." Forecasts were made three, four and five days ahead, and the results for a year are as follows:—

Temperature forecast.	Mean difference of temperature from Normal on days forecasted as:		
	Above Normal.	Normal.	Below Normal.
3 days ahead	+1·6	—0·6	—1·0
4 days ahead	+1·0	—0·2	—1·3
5 days ahead	+0·5	—0·1	—0·8

Complete accuracy would require the figures in the column under "high" to be above +5°F. and in that under "low" to be below —5°F. The results for weekly and monthly forecasts were similar. It is evident that although there must have been a large percentage of failures, the results are on the whole in the right direction.

The third paper, dealing with the results in the Argentine, enables us to enamine the present value of the new methods in greater detail. The 8 a.m. and 8 p.m. temperatures at Buenos Aires are predicted for a week in advance entirely from the solar observations (the daily forecast service is a separate department). These fourteen predictions are then correlated with the recorded temperatures. The method is not entirely satisfactory, since it takes account only of the changes from day to day and not of the general level of the figures. If the two curves, predicted and observed, ran exactly parallel, the correlation would be +1·0, although there might be a difference of 10°F. between them; on the other hand, if they were both much above normal, throughout, but fluctuated independently, the correlation would be zero or negative. Out of 131 correlation coefficients obtained in this way 87 were positive and 44 negative, and the algebraic mean of the whole series was +0·21. Only 30 coefficients, or 23 per cent. were above +0·6. These results, although they show that there is undoubtedly some connexion between solar variations and the subsequent

temperature at Buenos Aires, fall very far short of the high standard required in forecasting weather for practical purposes. The rainfall forecasts were more successful; rain fell on the day for which it was forecasted on 52 per cent. of the occasions.

It will be noticed that the pressure changes which bring about the changes of weather originate near the west coast of America on the same day as the change in solar radiation. This puts the eastern coasts in the most favourable position for long range forecasts based on solar observations. The weather of western Europe is largely governed by movement of barometric disturbances from the Atlantic, and here the relation between solar and meteorological changes is probably even more complex. A relation of some sort almost certainly exists and will be discovered by future research, but it will probably be long before this new method will be able to add anything to the high technique of daily forecasting by synoptic charts.

Discussions at the Meteorological Office

October 12th, 1925. *Die Schwankungen der atmosphärischen Zirkulation über dem Nordatlantischen Ozean im 25-jährigen Zeitraum*, 1881-1905. By A. Defant (Geog. Ann. Stockholm VI., 1924, p. 13). *Opener*—Mr. R. G. K. Lempfert, M.A.

Defant has devoted a great deal of attention to the monthly charts of the distribution of pressure over the North Atlantic, published by the Dansk Meteorologisk Institut, Copenhagen, and the Deutsche Seewarte, Hamburg. In this paper he classifies the monthly charts into four types, according to the latitudes in which the pressure was above or below normal, and thus boils down the data for each month into a single symbol (with an index of intensity.) He regards the frequency and intensity of different types as a measure of the activity of the atmospheric circulation over the North Atlantic, and compares it with other elements such as rainfall in Great Britain, ice in Iceland. Seeking for a cause of variations in the activity of the circulation, he finds that volcanic eruptions are important. In the year of a great eruption, the activity of the circulation is diminished; after the very greatest eruptions, such as Krakatoa in 1883, the circulation does not immediately settle down into its normal state, but oscillates for some time with a period of $3\frac{1}{2}$ years. An interesting discussion followed, in which the general feeling was that, in spite of the immense amount of labour which Defant had given to the work, no outstanding results had emerged. Mr. D. Brunt pointed out that the $3\frac{1}{2}$-year periodicity was very frequent in meteorological phenomena; Mr. F. J. W. Whipple said that it was impossible for the atmosphere as an atmosphere to have a periodicity of this length, because of the mobility of the air: there must be some other factor, which might be the snowfall.

October 26th, 1925. *Die atmosphärischen Elektrizität über den Meeren.* By K. Kähler (Ann. Hydr. Hamburg, Bd. 52, p. 201). *Opener*—Mr. R. E. Watson, B.Sc.

In spite of the difficulties of measurement on board ship, especially of potential gradient, many observations of atmospheric electrical phenomena have been made over the oceans, and the author of the above paper has collected together results published up to 1923. The data indicate that electrical phenomena over the oceans are of the same magnitude as over land, except that there is a large decrease in the radio-activity of the air and an increase in penetrating radiation on passing from land to water. Also, owing to the absence of pollution and the varying radio-active effect of the ground and the steadiness of meteorological conditions over the sea, electrical phenomena are more uniformly distributed over it than over the land. Mauchly's hypothesis, that the regular daily variation of potential gradient over the oceans depends on universal time, is not sufficiently confirmed.

During the discussion, Dr. Simpson described some of the experimental difficulties he had to overcome in carrying out electrical observations aboard ship, and emphasized the need for more accurate standardisation of all potential gradient records. Dr. Chree showed how the potential gradient is increased and the electrical conductivity of the air is reduced by the pollution in the air near large towns. He expressed the opinion that a more systematic co-ordination of observations is required before a general theory of the variation in the earth's electric field can be evolved.

The subjects for discussion for the next meetings will be :—

November 23rd, 1925. *The Kalahari Project.* By E. H. L. Schwarz (Matériaux pour l'étude des calamités, 1. (1925), pp. 291-332). *Opener*—Mr. C. W. Lamb, B.Sc.

December 7th, 1925. *Ozone as an absorbing material for Radiations in the Atmosphere.* By C. Fabry. (Pub. Mass. Inst. Tech., No. 281, 1925, pp. 20). *Opener*—Mr. C. E. Britton, B.Sc.

Correspondence

To the Editor, *The Meteorological Magazine*

Buddha's Glory

REFERRING to my description of " The Spectre of the Brocken," as seen by me on Scafell, in the August *Meteorological Magazine*, the following extract from a letter from West China is of interest. The writers are Mr. and Mrs. William G. Sewell. The former was late lecturer on applied chemistry at Leeds, is now in Chengtn

as missionary and as professor there in the Union University. He and his wife, spending their vacation on the "hills" 5,000 feet above the sea, climbed Gin Din "the Golden Summit," 11,000 feet high—the summit, a narrow ridge with numerous temples, overlooks a precipice, in one part having a sheer drop of a mile. The views, when not cloud hidden, can hardly be equalled, stretching for 200 miles to the lofty summits in Tibet. From their temple lodgings they saw "one of the 'miracles' of the mountains three times. At certain times of day, if the clouds are right, you can look over the edge and see your shadow on the clouds below. You are transfigured in the process and see yourself with a white halo and round that a semicircle of rainbow. It is called Buddha's glory. Pilgrims, seeing in it the welcoming Buddha, have leapt into its arms to be killed on the cliffs below. And then physics comes along and explains it all away—one more superstition is shattered and God is revealed purer and truer."

The *Children's Pictorial* of August 29th has a picture of the Brocken Spectre as seen that month from Cader Idris, but incorrectly centering the circles at the stomach instead of the eye!

J. EDMUND CLARK.

41, *Downscourt Road, Purley, Surrey. October 1st*, 1925.

A Curious Optical Phenomenon

ON the evening of Saturday, September 26th, I saw a very beautiful spectacle, and one which I had never previously witnessed. There was a shower that evening between 5 and 6 p.m., and shortly after 6 a rainbow appeared in the south-east, opposite my house. We were watching the rainbow—which appeared to rest on the hill top—along with two little boys of 5 years of age. Suddenly between us and the hill there appeared a number of bright, pure, white lights, with much sparkle. They seemed as brilliant and looked as big as motor headlights, and were all moving about in a cluster; one of the boys cried out: "Look at the aeroplanes painted silver!" The sky was dull and birds flying could not be seen distinctly from our position unless they rose above the hill top. The lights were midway up. They disappeared for a moment and then came into being again, when it was noticed that they were the reflection of light on a considerable number of black-headed seagulls all wheeling together, only the white undersides being illuminated as they wheeled in and out of a narrow belt, beyond which, on each side, they could hardly be picked up against the hill. I have said the light was reflected—and evidently from below—as there was no sunshine visible; and the light was confined to a certain space. On saying that what we

saw were not aeroplanes but birds, the other little boy said: "They have sparks inside."

The remarks of the children really gave a good description of the appearance and twinkling of the light. I thought the twinkle would be caused by the movement of the wings. If seen from a distance which made it impossible to see the birds, any spectator must have beheld it with great wonder.

Our point of observation was 450 feet above sea level. The hill top is from 600 to 700 feet above the same and the width of the valley at the place about $\frac{3}{8}$ mile. The gulls were flying at an elevation of probably 400 feet above sea level. The light might have been reflected from the river.

Probably such an occurrence may not be infrequent and can be explained. To us it was a sight not likely to be forgotten by the "grown-ups" who saw it. It lasted about 10 minutes.

JOHN G. WINNING.

Branxholme, Knowe, Hawick. October 1st, 1925.

[In connexion with the above, Major A. H. R. Goldie remarks that the "motor lamp," "silver," and "spark" effects in this particular case may have been due to the fact that coloured rays from the rainbow were available, and that each turn of the gulls flashed the various colours of the spectrum in succession into the eyes of the observers. Light reflected from the river may or may not have played a part.—Ed. *M.M.*]

NOTES AND QUERIES

The Third International Air Congress

THE Third International Air Congress was held at Brussels from the 6th to the 10th of October, under the Presidency of Major-General Von Crombrugge, Director-General of Aeronautical Services. About four hundred delegates attended; they included Sir Samual Hoare, Secretary of State for Air, and Air Vice-Marshal Sir Sefton Brancker, Director of Civil Aviation, from England; M. Laurent Eynac, Under Secretary of State for Aeronautics, France; and Signor Mercanti, the representative of Italy on the International Commission for Air Navigation.

The work of the Congress was divided into six sections, and after the opening meeting of the full Congress on Tuesday morning, the members separated to attend the meetings of the particular sections in which they were most interested. Over eighty papers had been received, and most delegates found that their time was very fully occupied. This was particularly the case with certain members, as meetings of the International Commission for Air Navigation and of the Conference on questions affecting civil aviation between Great Britain, France, Belgium and Holland were held during the same week.

It was gratifying to note that no less than fourteen of the papers were on meteorological subjects, a striking proof of the increasing recognition of the importance of meteorology in relation to the various aspects of aviation. In the Air Navigation Section, Lieut.-Colonel E. Gold read a paper on the computation of an index figure of fitness for flying at an aerodrome or along an air route to be used for statistical purposes, while Baron de Dorlodot contributed a note on the meteorological organisation for an air route. Most of the meteorological papers, however, were read in the Scientific Section. Commandant Jaumotte, Director of the Royal Meteorological Institute of Belgium, described the new meteorograph, which he has recently designed for obtaining upper air temperatures and humidities from aeroplanes, while Dr. Cannegieter of the Meteorological Institute, De Bilt, gave an account of a method which had been tried in Holland, of fixing a meteorograph inside the wing of an aeroplane in order to avoid the present disadvantage, from the aviator's point of view, of the exposure of a large instrument on some external portion of the machine. Ventilation is effected by series of holes suitably arranged in the upper and lower surfaces of the wing. Other contributions included a paper by Captain F. Entwistle on meteorology in relation to the selection of aerodrome sites, an account by Commandant Jaumotte of a method of obtaining stereoscopic cloud photographs from an aeroplane, and a paper by Messrs. Gregg and Zandt, the former of the United States Weather Bureau, on the effect of wind on the flight of an aeroplane as deduced from statistics of one year's record of the air mail service between New York and San Francisco.

In addition to the meetings of the different sections for the discussion of papers, visits were arranged to the technical aeronautical workshops at Seraing, near Liège, to the civil aerodrome at Evere, near Brussels, and to the Meteorological Institute at Uccle. The social side was by no means neglected, a large number of members attending, by invitation, an excellent performance, on Friday evening, of " Madame Butterfly," at the Théatre Royale, while earlier in the day, by courtesy of M. Max, the Burgomaster, an opportunity was afforded of visiting the beautiful and historic Hôtel de Ville.

The final meeting of the full Congress was held on Saturday afternoon, when the work of the various sections was reviewed and certain resolutions which had been proposed in the course of the week were ratified. A banquet was given to members of the Congress on Saturday evening, concluding with speeches from Sir Samual Hoare, M. Laurent Eynac, Signor Mercanti and others.

One could not but be struck with the excellent organisation, under the direction of the Secretary, Commandant Desoil, which ensured the smooth working of the Congress from start to finish.

This, combined with a week of brilliantly fine weather, helped to make the Congress a memorable occasion for those who were fortunate enough to participate in it.

F. E.

Radiation from the Sky

RADIATION MEASURED AT BENSON, OXON, 1925.

Unit: one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays)

Averages for Readings

		July	Aug.	Sept.
Cloudless days :—				
Number of readings	n	8	7	6
Radiation from sky in zenith ...	π I	576	570	491
Total radiation from sky ...	J	591	618	523
Total radiation from horizontal black surface on earth ...	X	786	787	721
Net radiation from earth ...	X—J	195	169	198

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days :—				
Number of readings	n_0	0	0	2
Radiation from sky in zenith ...	πI_0	—	—	46
Total radiation from sky ...	J_0	—	—	52
Cloudy days :—				
Number of readings	n_1	0	3	4
Radiation from sky in zenith ...	πI_1	—	171	169
Total radiation from sky ...	J_1	—	159	143

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

New Forecasting Service in Italy

BY a recent decree published by the Italian Commissariat for Aeronautics, the Forecasting Section of the Central Meteorological Office and the Aerological Section of the Higher Directorate

of Aeronautical Engineering will be combined into one department, dependent on the Commissariat and to be known as the "Weather Forecasts Department," with its headquarters at the Central Meteorological and Geophysical Office, Rome. The new department will collect observations and publish daily weather bulletins, carry out experiments with regard to meteorology as applied to aeronautics, test instruments for weather forecasting, and organize meteorological experiments with aircraft.

Obituary

Mr. F. J. Brodie.—The death of Mr. F. J. Brodie, which was briefly reported in the September number of the *Meteorological Magazine,* removes another of the old staff who for so many years carried on the work of the Meteorological Office. Brodie entered the Office as a boy clerk in 1869, during the second year of Dr. R. H. Scott's directorship, and about four years after the death of Admiral Fitzroy. I believe I am correct in saying that throughout his official career he was associated with what used to be called the Telegraphic Branch, which has now become the Forecast Division. For many years he and the late Frederick Gaster were the working heads of the division. Practically every forecast that was issued was prepared by one or other of them, and, as far as I have been able to find out, there was no margin for sickness or leave. If either of the seniors was away, the other just carried on, with such assistance as he could get from any of the junior staff. When I entered the Office in 1902, Gaster's health was beginning to fail, and Mr. R. Sargeant had just been put on the regular roster for forecast duty. The work of the division was increasing rapidly both in amount and in strenuousness, and, with the change in the hour of morning observations from 8 a.m. to 7 a.m. looming in sight, it was necessary to further strengthen the forecast staff. Mr. H. Harries was therefore transferred from the Marine Division, and presently, after a lengthy course at forecast checking under Gaster and Brodie's supervision—then our recognized method of training forecasters—I was also allowed to try my 'prentice hand, and we had thus a team of four forecasters.

After a year or two, I was transferred to other work, and I came in contact with Brodie but rarely, but in 1910 the Office was transferred from 63, Victoria Street, to South Kensington, and at the same time a superintendentship was attached to the Forecast Division. I was appointed to the post and Brodie thus became my principal assistant. No doubt the consciousness that the work was increasing rapidly—the advent of wireless telegraphy was changing the complexion of routine forecasting—made the assistance of a younger man in some ways desirable, but the position cannot have been an easy one for a man who had

for many years been the head of his department. I therefore welcome this opportunity of placing on record my gratitude for the manner in which he received me into the division and for the unfailing courtesy which he always extended to me. A smaller man would have found many opportunities for making things difficult. As a forecaster Brodie had many excellent qualities. The Office forecasts often were, and probably still are, made the subject for jest. It is no easy task to compress a description of a day's weather over a district into a sixpenny telegram, but Brodie's terseness of style came to his aid and he generally accomplished the task extremely well. Rarely did his forecasts read like an utterance of the Delphic oracle, and then only when the weather was of so indecisive a type that precision was impossible. Forecasting in his day was practically entirely empirical, but by long experience he had developed a kind of intuition of coming changes. I sometimes challenged him for his reasons for issuing what appeared to me a risky gale warning, but all I could extract was: "Oh, I think it is going to blow," and as a general rule it did, but of course there were exceptions. When that happened, his comment was: "Well, as Gaster used to say, I'd do it again next time." In such cases he worked by no formulated or formulable rule, all he had to go upon was a recollection stored away somewhere at the back of his brain of a previous map showing similar characteristics.

Apart from forecasting, he took a keen interest in meteorology. For his own satisfaction he prepared summaries of the observations which he had to handle in the course of his official duties, and from time to time these resulted in valuable statistical papers. His papers on the prevalence of gales on the coasts of the British Isles for the 30 years, 1871-1900, in the *Quarterly Journal of the Royal Meteorological Society*, still form perhaps the most complete statistical summary of the subject that we have, while in a paper on the incidence of bright sunshine over the United Kingdom during the 30 years, 1881-1910, which also appeared in the *Journal*, he anticipated work which the Office subsequently did in the *Book of Normals*. He was particularly interested in the statistics of fog for London and kept a record of his own in which he combined the results for the various London stations in a way which he hoped might eliminate the personal equation and variations in the standard by which different observers judge a fog. Even with the modern Visibility Scale it may be doubted whether absolute homogeneity is attained, but the older statistics are manifestly deficient in this respect. Brodie's series, also published in the *Journal*, probably comes nearer than most to attaining the desired end.

——— R. G. K. LEMPFERT.

Mr. J. Ellis Mace. The death occurred, on September 19th,

of Mr. J. Ellis Mace in his 78th year. As a lad he set up a rain-gauge at Tenterden in Kent and maintained the records continuously from June, 1863, until a few days before his death. He had thus more than 62 years' observations to his credit, a record which is only exceeded by that of the veteran Mr. W. S. Clark, of Street, Somerset, whose records appeared in the first volume of *English Rainfall*, that for 1860. Mr. Mace's records have appeared for many years in the rainfall tables in this magazine and they have also been utilized in the preparation of a series of rainfall normals recently published as Section V. of the *Book of Normals for the British Isles*. The study of the weather remained a subject of absorbing interest to him throughout his life; only a fortnight before his death, when forwarding his records for August, he added a series of notes on the weather on individual days during the month and the effects on harvest operations. H. E. C.

We regret to announce the death, on October 19th, of Mr. W. R. C. Chillman, Office Keeper for ten years in the Meteorological Office, South Kensington.

We regret to learn that Professor A. A. Friedmann, who has been Director of the Central Geophysical Observatory of Russia since February 5th, 1925, died on September 16th, at the age of 37, after a short, painful illness.

We also regret to learn of the death on August 17th, at Buenos Aires, at the age of 45 years, of Dr. A. Merz, chief scientist of the German Atlantic Expedition, 1925, Director of the Oceanographical Institute and Museum at Berlin, and Professor of Geography in the University.

News in Brief

Captain W. Ellery, Principal Examiner of Masters and Mates, has been nominated by the Board of Trade to succeed the late Captain Warden as their representative on the Meteorological Committee.

At the annual statutory meeting of the Royal Society of Edinburgh, held on Monday, October 26th, Dr. A. Crichton Mitchell, formerly Superintendent of the Meteorological Office, Edinburgh, was appointed Curator of the Library and Museum of this society.

A mass meeting of Civil Servants will be held in the Royal Albert Hall on November 17th. The object of the meeting is to enlighten public opinion as to the actual conditions of the Service and to protest against unfair criticism.

Erratum

October, 1925, p. 224, line 35, *for* " somewhat below normal " *read* " somewhat above normal."

The Weather of October, 1925

APART from some rather cold weather just before the middle of the month, October, 1925, was predominatingly mild, the first half of the month was dry and sunny, the second half unsettled windy and wet. During the first week high pressure over the British Isles was associated with local mist or fog and high temperatures; maxima exceeded 70° F. in several instances, and reached 75° F. at Cullompton on the 4th, while minima varying between 55° F. and 60° F. were registered in several places. By the 8th, the winds had become north or north-east generally, and this change was accompanied by a marked drop in temperature. Thick fog developed in most parts of England and Ireland on the morning of the 11th, but by the 12th the anticyclone which had been over the British Isles withdrew a little westwards again and a definite northerly wind current set in over the eastern districts. Snow, sleet and hail showers were experienced in Scotland and east England during the next few days, and "snow lying" to a depth of 1 in. was reported from Balmoral on the 14th and 17th. A thunderstorm occurred at Aberdeen on the 14th, and at Elgin on the 17th. The lowest temperatures of the month were recorded at this period, a screen minimum of 17° F. being reported from West Linton (Peebles) on the 16th, and a grass minimum of 13° F. from Rhayader (Radnor) on the 14th. At Ross-on-Wye, 10·0 hrs. bright sunshine were recorded on the 14th, the latest date on which 10 hrs. has ever been registered at this station. So far, precipitation, except in a few districts, had been scanty, but by the 15th depressions were beginning to approach from the Atlantic and within a few days mild cyclonic conditions prevailed with high winds and heavy rain at times, which continued until the end of the month. Gales were experienced on some parts of the coasts on the 22nd-23rd, 26th-27th, 29th and 31st. Amongst the heaviest falls of rain were 57 mm. (2·23 in.) and 76 mm. (2·98 in.) at Tynywaun (Glamorgan) on the 19th and 20th respectively, 52 mm. (2·05 in.) at Holne (Devon) on the 22nd, 138 mm. (5·425 in.) at Lake Llydaw, Snowdon, on the 25th, and 47 mm. (1·85 in.) at Seskin (Waterford) on the 29th. Some of the nights were unusually warm for the time of year, especially on the 21st, when the temperature did not fall below 60° F. at Kew. Total rainfall for the month varied considerably, being 156 per cent. of the normal at Dolaucothy (Carmarthen) and 42 per cent. at North Berwick (Haddington).

Pressure was below normal over Scandinavia, the British Isles and the greater part of the North Atlantic, the deficit amounting to 9 mb. at Vardo (Norway) and St. Johns (Newfoundland). Over Iceland and a region extending from the English Channel to Prague and Algiers, pressure was above normal. Temperature

was high over southern and western Europe, but nearly 4° F. below normal in parts of Scandinavia. Rainfall was generally below normal, the deficit being 68 mm. at Zürich. At the beginning of the month a severe storm occurred in the Persian Gulf, when 1,000 lives and 40 boats were lost, and on the 4th, gales in the Gulf of Bothnia resulted in the loss of a Finnish torpedo boat. Owing to the heavy rains early in the month, the railway bridge over the Penzio, a few miles from Badolato, was swept away and a serious railway accident occurred. Several other bridges fell later. Snowfalls were reported from Westphalia about the 20th.

Five people were killed in a gale which swept over New York City for sixteen hours on the 10th. On that day, temperature did not rise above 40° F. in the city, and the lakes throughout New England were frozen thick enough for skating. A tornado originating in Texas reached its greatest violence in Alabama on the 25th, and severe gales occurred in most of the eastern states on that day. From the 19th to the end of the month, gales were continuously reported by ships from one or other parts of the North Atlantic, force 10 (59 m.p.h.) being recorded by a Scandinavian ship at 1 h. on the 20th in 55° N. 31° W, and by the "Caronia" at 13 h. on the 26th in 51° N, 15° W. Five inches of rain fell in Calcutta on the 15th, one of the heaviest downpours recorded in that city for October. The rainfall of Australia was generally about 25 mm. (1 in.) below normal.

In Africa, heavy rains in Morocco on the 12th and 13th put an end for a time to military operations, and in the Kalahari districts, Professor Schwarz, head of the Kalahari Survey Expedition, was forced to return in a dug-out canoe on the Botletle River to Pretoria on account of the floods which are the results of the heavy rains of last season. It is said to be 25 years since there was sufficient water in the Botletle River even for a dug-out canoe, and Lake Ngami has turned from a swamp into a lake about 30 miles wide.

The special message from Brazil states that the rainfall was irregular in the northern districts, being 6·5 mm. under the normal, plentiful in the central districts, where it was 15·6 mm. above the normal, and abundant in the southern districts, with 103·7 mm. above the normal. The weather was generally favourable to crops and vegetables, but temperature was abnormally low in the south and parts of the central districts. At Rio de Janeiro pressure was 0·6 mb. above normal, and temperature 2·5° F. below normal.

Rainfall October, 1925—General Distribution

England and Wales ..	103	per cent. of the average 1881-1915.
Scotland	98	
Ireland	105	
British Isles	102	

Rainfall: October, 1925: England and Wales

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Lond.	Camden Square.....	3·09	79	117	*War.*	Birminghm, Edgbaston	3·72	94	134
Sur .	Reigate, Hartswood...	3·52	89	112	*Leics*	Thornton Reservoir ..	3·45	88	123
Kent.	Tenterden, Ashenden..	4·19	106	120	,, .	Belvoir Castle.....	2·72	69	101
,, .	Folkestone, Boro. San.	3·31	84	...	*Rut .*	Ridlington.....	3·12	79	...
,, .	Broadstairs, St. Peter's	...	..	...	*Linc.*	Boston, Skirbeck	2·35	60	86
,, .	Sevenoaks, Speldhurst.	4·50	114	...	,, .	Lincoln, Sessions House	2·23	57	87
Sus .	Patching Farm.....	3·85	98	97	,, .	Skegness, Estate Office.	1·97	50	72
,, .	Brighton, Old Steyne .	3·93	100	104	,, .	Louth, Westgate	2·50	63	77
,, .	Tottingworth Park....	5·30	135	128	,, .	Brigg	2·37	60	79
Hants	Ventnor, Roy. Nat. Hos.	3·72	95	95	*Notts.*	Worksop, Hodsock....	2·51	64	95
,, .	Fordingbridge, Oaklnds	4·57	116	110	*Derby*	Mickleover, Clyde Ho..	3·51	89	130
,, .	Ovington Rectory	3·66	93	90	,, .	Buxton, Devon. Hos...	6·56	167	134
,, .	Sherborne St. John Rec.	3·88	99	110	*Ches.*	Runcorn, Weston Pt...	4·49	114	131
Berks	Wellington College...	1·96	50	60	,, ..	Nantwich, Dorfold Hall	3·39	86	...
,, .	Newbury, Greenham..	4·35	111	124	*Lancs*	Manchester, Whit. Pk.	4·28	109	130
Herts.	Benington House	2·92	74	107	,, ..	Stonyhurst College....	5·57	141	124
Bucks	High Wycombe	3·57	91	114	,, ..	Southport, Hesketh....	4·19	106	118
Oxf..	Oxford, Mag. College..	2·41	61	86	,, ..	Lancaster, Strathspey.	5·66	144	...
Nor .	Pitsford, Sedgebrook..	3·32	84	124	*Yorks*	Sedbergh, Akay	7·17	182	144
,, .	Eye, Northolm.....	2·42	61	...	,, .	Wath-upon-Dearne ...	2·52	64	91
Beds.	Woburn, Crawley Mill.	2·99	76	110	,, .	Bradford, Lister Pk...	3·65	93	105
Cam.	Cambridge, Bot. Gdns.	2·51	64	106	,, .	Wetherby, Ribston H..	3·04	77	101
Essex	Chelmsford, County Lab	2·67	68	109	,, .	Hull, Pearson Park ...	2·39	61	80
,, .	Lexden, Hill House...	2·65	67	...	,, .	Holme-on-Spalding ...	2·71	69	...
Suff .	Hawkedon Rectory ...	2·79	71	103	,, .	West Witton, Ivy Ho..	3·80	97	...
,, .	Haughley House.....	1·94	49	...	,, .	Felixkirk, Mt. St. John	2·60	66	90
Norf.	Beccles, Geldeston....	1·54	39	55	,, .	Pickering, Hungate ...	2·55	65	...
,, .	Norwich, Eaton	1·70	43	54	,, .	Scarborough.....	1·61	41	51
,, .	Blakeney	2·02	51	77	,, .	Middlesbrough	2·53	64	84
,, .	Swaffham	2·27	58	79	,, .	Baldersdale, Hury Res.	3·73	95	95
Wilts.	Devizes, Highclere....	3·21	81	103	*Durh.*	Ushaw College	2·65	67	77
,, .	Bishops Cannings	3·00	76	90	*Nor .*	Newcastle, Town Moor.	1·60	41	50
Dor .	Evershot, Melbury Ho.	5·63	143	122	,, .	Bellingham, Highgreen	2·87	73	...
,, .	Weymouth, Westham..	...	..	...	,, .	Lilburn Tower Gdns...	2·05	52	...
,, .	Shaftesbury, Abbey Ho.	...	..	...	*Cumb*	Geltsdale.....	3·44	87	...
Devon	Plymouth, The Hoe...	3·50	89	89	,, .	Carlisle, Scaleby Hall .	3·86	98	116
,, .	Polapit Tamar	4·42	112	92	,, .	Seathwaite M.....	16·30	414	136
,, .	Ashburton, Druid Ho..	6·67	169	110	*Glam.*	Cardiff, Ely P. Stn.....	6·00	152	125
,, .	Cullompton	3 58	91	87	,, .	Treherbert, Tynywaun	13·50	343	...
,, .	Sidmouth, Sidmount ..	3·26	83	88	*Carm*	Carmarthen Friary....	7·21	183	126
,, .	Filleigh, Castle Hill ...	4·67	119	...	,, .	Llanwrda, Dolaucothy.	9·90	251	156
,, .	Barnstaple, N.Dev.Ath.	4·59	117	101	*Pemb*	Haverfordwest, School	6·60	168	122
Corn.	Redruth, Trewirgie ...	4·90	125	93	*Card.*	Gogerddan.....	4·79	122	91
,, .	Penzance, Morrab Gdn.	3·70	94	79	,, .	Cardigan, County Sch. .	5·17	131	...
,, .	St. Austell, Trevarna..	4·51	115	86	*Brec .*	Crickhowell, Talymaes	6·00	152	...
Soms	Chewton Mendip	4·79	122	99	*Rad .*	Birm. W. W. Tyrmynydd	6·92	176	105
,, .	Street, Hind Hayes ...	2·80	71	...	*Mont.*	Lake Vyrnwy	7·23	184	127
Glos..	Clifton College	3·80	97	101	*Denb.*	Llangynhafal	3·74	95	...
,, .	Cirencester	3·50	89	103	*Mer .*	Dolgelly, Bryntirion..	6·86	174	113
Here.	Ross, Birchlea	3·04	77	92	*Carn.*	Llandudno	3·85	98	107
,, .	Ledbury, Underdown.	2·97	75	96	,, .	Snowdon, L. Llydaw 9	23·23	590	...
Salop	Church Stretton.....	4·12	105	114	*Ang .*	Holyhead, Salt Island.	3·87	98	97
,, .	Shifnal, Hatton Grange	3·44	87	122	,, .	Lligwy	4·78	121	...
Staff.	Tean, The Heath Ho...	4·72	120	146	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	2·92	74	109		Douglas, Boro' Cem...	4·40	112	95
,, .	Blockley, Upton Wold.	3·67	93	112	*Guernsey*				
War.	Farnborough.....	3·92	100	124		St. Peter P't, Grange Rd	3·42	87	76

Rainfall: October, 1925: Scotland and Ireland

CO.	STATION	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	3·49	89	96	*Suth.*	Loch More, Achfary...	9·62	244	123
,, .	Pt. William, Monreith.	3·88	99	...	*Caith*	Wick	2·91	74	98
Kirk.	Carsphairn, Shiel.	9·78	248	...	*Ork .*	Pomona, Deerness	4·40	112	116
,, .	Dumfries, Cargen.....	6·00	152	138	*Shet .*	Lerwick	4·72	120	119
Dum	Drumlanrig	5·65	143	131					
Roxb	Branxholme	3·40	86	105	*Cork.*	Caheragh Rectory	6·10	155	...
Selk .	Ettrick Manse.....	6·67	169	...	,, ..	Dunmanway Rectory.	6·80	173	113
Berk.	Marchmont House	2·17	55	57	,, ..	Ballinacurra	4·79	121	118
Hadd	North Berwick Res....	1·24	31	42	,, ..	Glanmire, Lota Lo. ...	5·37	136	129
Midl	Edinburgh, Roy. Obs..	1·83	47	71	*Kerry*	Valencia Obsy.	4·59	117	82
Lan .	Biggar	3·54	90	118	,, .	Gearahameen	10·30	262	...
Ayr .	Kilmarnock, Agric. C..	3·60	91	103	,, .	Killarney Asylum.....	6·65	169	124
,, .	Girvan, Pinmore.....	6·18	157	124	,, .	Darrynane Abbey	5·20	132	103
Renf.	Glasgow, Queen's Pk..	2·90	74	89	*Wat .*	Waterford, Brook Lo..	4·32	110	110
,, .	Greenock, Prospect H..	6·24	159	116	*Tip .*	Nenagh, Cas. Lough...	3·57	91	105
Bute.	Rothesay, Ardencraig.	5·32	135	121	,, .	Tipperary	4·42	112	...
,, .	Dougarie Lodge	4·21	107	...	,, .	Cashel, Ballinamona ..	3·81	97	106
Arg .	Ardgour House	7·69	195	...	*Lim .*	Foynes, Coolnanes	3·87	98	104
,, .	Manse of Glenorchy..	7·50	191	...	,, .	Castleconnell Rec.	4·23	107	...
,, .	Oban	4·27	109	...	*Clare*	Inagh, Mount Callan ..	6·57	167	...
,, .	Poltalloch	5·71	145	115	,, .	Broadford, Hurdlest'n.	4·86	123	...
,, .	Inveraray Castle.....	6·37	162	90	*Wexf*	Newtownbarry	4·32	110	...
,, .	Islay, Eallabus.....	5·13	130	118	,, .	Gorey, Courtown Ho...	4·97	126	140
,, .	Mull, Benmore	11·60	295	...	*Kilk.*	Kilkenny Castle.....	3·58	91	114
Kinr.	Loch Leven Sluice	2·93	74	85	*Wic .*	Rathnew, Clonmannon	4·55	116	...
Perth	Loch Dhu	8·35	212	117	*Carl .*	Hacketstown Rectory .	3·83	97	101
,, ..	Balquhidder, Stronvar.	7·03	179	103	*QCo..*	Blandsfort House.....	3·37	86	96
,, ..	Crieff, Strathearn Hyd.	4·11	104	105	,,	Mountmellick	3·98	101	...
,, ..	Blair Castle Gardens ..	3·63	92	117	*KCo.*	Birr Castle.....	2·17	55	75
,, .	Coupar Angus School..	3·16	80	111	*Dubl..*	Dublin, FitzWm. Sq...	2·41	61	90
Forf.	Dundee, E. Necropolis.	2·36	60	89	,, .	Balbriggan, Ardgillan .	2·58	65	95
,, .	Pearsie House.....	3·81	97	...	*Me'th*	Drogheda, Mornington	2·39	61	...
,, .	Montrose, Sunnyside..	2·22	56	80	,, .	Kells, Headfort.....	3·45	88	103
Aber.	Braemar, Bank	3·33	85	89	*W.M*	Mullingar, Belvedere .	3·79	96	121
,, .	Logie Coldstone Sch. ..	1·96	50	60	*Long*	Castle Forbes Gdns....	3·84	97	118
,, .	Aberdeen, King's Coll..	2·68	68	89	*Gal .*	Ballynahinch Castle ..	6·29	160	105
,, .	Fyvie Castle	2·68	68	...	*Mayo*	Mallaranny.....	6·02	153	...
Mor .	Gordon Castle.....	2·67	68	84	,, .	Westport House.....	4·54	115	101
,,	Grantown-on-Spey....	2·51	64	84	,, .	Delphi Lodge	9·89	251	...
Na .	Nairn, Delnies.....	1·68	43	71	*Sligo*	Markree Obsy.	3·83	97	94
Inv..	Ben Alder Lodge	3·87	98	...	*Cav'n*	Belturbet, Cloverhill..	2·91	74	100
,, .	Kingussie, The Birches	2·06	52	...	*Ferm*	Enniskillen, Portora ..	3·71	94	...
,, .	Loch Quoich, Loan....	...	..	...	*Arm.*	Armagh Obsy.	2·46	63	90
,, .	Glenquoich	...	..	...	*Down*	Warrenpoint	3·32	84	...
,, .	Inverness, Culduthel R.	1·84	47	...	,, .	Seaforde	4·76	121	134
,, .	Arisaig, Faire-na-Squir	3·75	95	...	,, .	Donaghadee, C. Stn...	2·88	73	100
,, .	Fort William.....	6·66	169	95	,, .	Banbridge, Milltown .	2·65	67	96
,, .	Skye, Dunvegan.....	6·35	161	...	*Antr.*	Belfast, Cavehill Rd. .	3·84	97	...
,, .	Barra, Castlebay	2·29	58	...	,, .	Glenarm Castle.....	3·97	101	...
R&C	Alness, Ardross Cas. ..	2·34	59	61	,, .	Ballymena, Harryville	3·57	91	97
,, .	Ullapool.....	4·86	124	...	*Lon .*	Londonderry, Creggan	3·08	78	84
,, .	Torridon, Bendamph..	6·57	167	82	*Tyr .*	Donaghmore	3·33	85	...
,, .	Achnashellach	7·34	186	...	,, .	Omagh, Edenfel	...	..	...
,, .	Stornoway	4·73	120	91	*Don .*	Malin Head	2·56	65	87
Suth.	Lairg	3·19	81	...	,, .	Rathmullen.....	3·52	89	...
,, .	Tongue Manse.....	4·35	111	104	,, .	Dunfanaghy	...	.	...
,, .	Melvich School.....	4·07	103	111	,, .	Killybegs, Rockmount.	6·29	160	112

Climatological Table for the British Empire, May, 1925

STATIONS	PRESSURE		TEMPERATURE						Mean Wet Bulb.	Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values											
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal				Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1009·5	— 6·4	77	38	63·9	47·1	55·5	+ 2·1	49·5	85	6·5	48	+ 4	18	6·4	41
Gibraltar	1016·6	+ 0·5	77	53	71·3	56·7	64·0	— 1·5	55·0	74	3·6	8	— 36	2	...	...
Malta	1012·2	— 2·8	75	53	67·9	59·9	63·9	— 2·0	59·2	78	5·8	39	+ 29	4	7·4	53
Sierra Leone	1011·8	+ 0·1	94	69	89·9	73·2	81·5	— 0·5	76·7	77	4·4	144	—139	13	...	...
Lagos, Nigeria	1009·2	— 1·8	91	72	88·3	77·0	82·7	+ 1·5	78·3	80	7·8	309	+ 46	18	...	...
Kaduna, Nigeria	1012·5	— 0·6	94	...	89·0	...	...	...	72·4	71	1·6	128	— 23	15	...	...
Zomba, Nyasaland	1014·5	— 0·9	83	49	75·1	57·1	66·1	+ 0·4	...	88	6·1	40	+ 13	9	...	...
Salisbury, Rhodesia	1015·6	— 1·4	79	41	72·5	49·3	60·9	+ 0·4	54·9	67	2·3	21	+ 9	4	8·7	77
Cape Town	1018·2	+ 0·3	86	41	70·6	51·0	60·8	+ 1·8	52·4	85	4·0	37	— 56	7	...	...
Johannesburg	1019·4	— 0·9	69	32	61·0	43·4	52·2	— 2·2	44·8	64	3·0	38	+ 20	6	7·6	70
Mauritius	1016·2	— 0·2	83	63	80·4	67·3	73·9	+ 1·3	72·3	81	5·1	57	— 20	19	8·3	75
Bloemfontein	...	...	74	31	63·4	38·5	50·9	— 1·8	44·0	86	3·3	59	+ 29	10	...	...
Calcutta, Alipore Obsy.	1002·7	— 0·8	103	73	95·3	78·8	87·1	+ 1·1	79·5	81	5·1	119	— 27	7*	...	...
Bombay	1006·5	— 0·9	93	77	92·0	81·8	86·9	+ 1·0	78·3	71	4·8	70	+ 56	3*	...	...
Madras	1005·2	— 0·2	104	71	97·0	79·7	88·3	— 1·6	78·0	67	4·9	103	+ 76	4*	...	...
Colombo, Ceylon	1008·5	— 0·1	89	75	87·6	77·7	82·7	+ 0·2	79·1	74	7·8	204	—125	29	6·8	55
Hong Kong	1007·7	— 1·7	89	65	82·3	74·1	78·2	+ 0·8	74·0	79	8·7	66	—229	13	5·5	42
Sandakan	...	...	91	74	88·8	76·6	82·7	+ 0·1	77·1	79	...	115	— 37	9	...	...
Sydney	1015·0	— 3·6	75	49	67·0	54·2	60·6	+ 2·0	56·0	79	5·8	509	+378	19	4·3	41
Melbourne	1017·5	— 2·0	74	37	61·3	48·1	54·7	+ 0·6	50·8	87	8·6	37	— 18	9	2·6	26
Adelaide	1017·6	— 2·5	74	41	64·5	50·1	57·3	— 0·5	51·9	71	6·4	78	+ 9	17	4·4	43
Perth, W. Australia	1016·3	— 2·2	81	43	69·0	53·2	61·1	+ 0·5	55·7	73	5·5	126	+ 2	19	5·6	54
Coolgardie	1017·3	— 2·5	77	41	65·7	48·4	57·1	— 0·5	51·2	71	6·4	15	— 20	4	...	...
Brisbane	1014·2	— 4·7	78	47	71·7	55·9	63·8	— 0·6	58·1	72	5·3	151	+ 78	13	6·2	58
Hobart, Tasmania	1020·6	+ 5·0	65	35	56·2	45·6	50·9	+ 0·5	46·4	83	6·8	87	+ 40	18	3·5	36
Wellington, N.Z.	1019·3	+ 4·1	69	36	58·2	47·2	52·7	— 0·2	49·4	78	7·2	160	+ 39	17	3·6	37
Suva, Fiji	1011·0	— 1·8	86	69	83·2	73·0	78·1	+ 1·6	74·8	82	6·3	253	— 5	22	...	...
Apia, Samoa	1011·0	— 0·1	87	69	83·9	73·5	78·7	+ 0·3	76·2	81	6·8	599	+459	21	4·5	39
Kingston, Jamaica	1012·8	— 0·3	89	68	87·3	71·9	79·6	— 0·1	72·2	78	4·6	80	— 30	4	...	...
Grenada, W.I.	1014·2	+ 1·6	88	72	85·6	74·7	80·1	+ 0·6	74.5	70	4·8	26	— 92	10	...	...
Toronto	1013·9	— 0·9	81	30	60·7	41·0	50·9	— 1·8	44·7	70	4·9	33	— 43	10	6·9	47
Winnipeg	1015·3	+ 1·0	83	22	63·5	38·2	50·9	— 0·7	...	...	4·5	7	— 50	7	6·9	45
St. John, N.B.	1012·2	— 1·8	63	35	54·1	39·9	47·0	— 0·7	43·0	74	6·4	44	— 50	12	6·6	44
Victoria, B.C.	1015·5	— 0·9	84	42	63·2	47·4	55·3	+ 2·2	50·6†	75†	6·0†	14	— 19	5	9·5	63

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.
† Observations of wet bulb, relative humidity and cloud amount refer to 9h. from May, 1925.